Clermont County Office of Environmental Quality
2006 Water Quality Sampling Final Report

Introduction

In 1996, Clermont County established a monitoring program to characterize surface water quality within the county. Data collected through this program allow the county to analyze watershed conditions, identify potential water quality problems, support planning and management programs, and track trends and progress over time. Marking the eleventh year of the program, the 2006 sampling schedule was designed with these goals in mind, and consisted of three distinct, yet related components. The first involved bi-weekly collection of grab samples from Shayler Run, Hall Run and Wolfpen Run in the lower East Fork Little Miami River watershed. These samples were analyzed for nitrite-nitrate (NO_2-NO_3), dissolved ortho-phosphates (ortho-P), total phosphorus (TP), total suspended solids (TSS), and *E. coli*. Results of these analyses will be compared to past and future data to track trends within the watershed over time. Also, effluent samples were collected on the same bi-weekly schedule from a number of semi-private sewage treatment plants. In addition to the large municipal sewage treatment plants, which are regulated by the Ohio EPA (OEPA) through a permitting process, there are a number of small package: plants serving mobile home parks, summer camps, schools, golf courses, and other properties throughout the county. Depending on the volume of water they treat, these plants may or may not be individually permitted by OEPA. This summer, effluent samples were collected from a number of these facilities in order to determine what contribution, if any, they are making to pollutant loads in the county's rivers and streams.

The second component of the 2006 sampling program involves investigating potential illicit discharges into the surface waters within Clermont County by conducting dry weather sampling above and below suspected discharges. By sampling in low-flow conditions, any water quality issues can be more easily identified with specific point source discharges, as opposed to the more diffuse, non-point source runoff associated with storm events. Areas targeted for this study included the community of Newtonsville and the Happy Hollow watershed in Milford. Samples in this study were analyzed for the same parameters as those in the ambient sampling program.

The third component of the county's water quality monitoring program in 2006 involves the collection of water samples at the county's long-term monitoring stations located on Shayler Run (SHYLER1.7) and Hall Run (HALL0.2) during storm events (wet weather sampling). Unlike the dry weather sampling described above, which is aimed at identifying specific sources of illicit discharge, the wet weather sampling is intended to quantify the cumulative impacts of major rain events, which serve to flush contaminants such as chemicals from agricultural applications, oil and gas from parking lot run-offs and other contaminants that cannot be identified as coming from any specific point (hence the term non-point source pollution). These types of stressors primarily enter streams during and immediately after rainstorms, and this component of the sampling program is intended to capture these events. In this way, the county can determine the

magnitude of these non-point source loadings, and monitor the effectiveness of programs designed to eliminate or reduce them.

During the May-October sampling season, five wet weather events were sampled on Shayler Run (July 28, September 18, September 28, October 5 and October 11), while only four events were sampled on Hall Run (July 28, September 18, October 5 and October 11). Samples were collected using an ISCO 6700 series refrigerated autosampler. The autosampler was programmed to collect six sets of samples collected at one and one-half hour intervals after the stream exceeded a pre-determined level. These samples are then aggregated into three composite samples representing the rise, peak, and fall of the stream in response to the storm event. Level and rainfall data were also recorded at the stations using an ISCO 4220 submerged probe flow meter and an ISCO 670 tipping-bucket rain gauge, respectively. Samples collected by the autosampler were analyzed for NO_2-NO_3, ortho-P, TP, TSS, and *E. coli*.

This report summarizes the results of these three components of the county's 2006 sampling program. The county also collected information on fish and invertebrate communities in six locations located throughout the county this summer, following Ohio EPA standard operation procedures. Measuring the biological communities in the stream provides an integrated assessment of stream quality over time, and eliminates the risk of missing a significant event by not collecting samples for chemical analysis at the correct time. Results of these studies are presented in a separate report.

Ambient Sampling - Streams

Weather and Stream Conditions During Sampling

Samples collected from the Hall Run, Shayler Run and Wolfpen Run locations were characterized as either "dry" or "wet" samples, based on the amount of precipitation received over the 48 hours preceding sample collection. If less than 0.1 inches of rain fell in the 48 hours before the time of sampling, the sample was classified as dry weather samples. If 0.1 inches of rain or more fell during the 48 hour period, the sample was categorized as a wet weather sample. The sample set dates and categories are provided in Table 1 below.

By identifying the weather conditions preceding each sampling event, it is hoped that contaminant concentrations can be linked to base- or low-flow conditions, or high-flow associated with stormwater run-off, thus providing valuable diagnostic information regarding potential source(s) of pollution. However, because this component of the county's sampling program involves set bi-weekly sampling, it is often observed that even so-called wet weather sampling occurs at times when the stream has nearly returned to base-flow conditions.

Table 1. Weather conditions in 48 hour period prior to time of sampling.

Sample Date	Sample Category	Precipitation @ Hall Run RM 0.2	Precipitation @ Shayler Run RM 1.7
May 11	Dry	0.09	0.06
May 25	Wet	0.24	0.24
June 7	Dry	0.00	0.00
June 21	Wet	0.24	0.34
July 6	Wet	0.10	0.32
July 19	Wet	1.12	0.69
August 1	Dry	0.00	0.00
August 15	Dry	0.08	0.08
August 29	Wet	0.93	0.94
September 14	Wet	1.35	1.55
September 28	Wet	0.42	0.42
October 19	Dry	0.01	0.01

Ambient Stream Sampling Results

Nutrients

Nitrite-nitrate and phosphorus data are presented in Table 2 below:

Table 2. Nutrient concentrations in Hall Run, Shayler Run and Wolfpen Run, May - October, 2006.

Sampling Location/ Parameter	NO_2-NO_3 (mg/L)	Ortho-Phosphate (dissolved) (mg/L)	Total Phosphorus (mg/L)
HALL0.2			
Dry Average	0.42	0.04	0.07
Wet Average	0.47	0.06	0.10
Maximum	1.01 (Dry)	0.09 (Wet)	0.18 (Wet)
Minimum	0.11 (Wet)	> 0.02 (Both)	0.03 (Dry)
SHYLR1.7			
Dry Average	0.35	0.03	0.05
Wet Average	0.33	0.04	0.07
Maximum	0.78 (Wet)	0.06 (Both)	0.12 (Wet)
Minimum	0.14 (Wet)	> 0.02 (Both)	0.03 (Both)
WLFPN0.1			
Dry Average	0.92	0.16	0.20
Wet Average	1.09	0.23	0.27
Maximum	1.67 (Dry)	0.30 (Wet))	0.37 (Wet)
Minimum	0.38 (Dry)	0.09 (Dry)	0.12 (Dry)

For nutrients, there does not appear to be a significant difference between the wet weather and dry weather data for samples collected in 2006. Average values for all parameters are approximately the same, and for some site/nutrient combinations, the highest values were associated with dry weather.

The NO_2-NO_3 concentrations measured at Shayler Run in 2006 are relatively low. Even the maximum observed NO_2-NO_3 concentration at this site (0.84 mg/L) is below the Ohio EPA's proposed ambient criteria value of 1.0 mg/L (*Association Between Nutrients, Habitat, and the Aquatic Biota of Ohio Rivers and Streams*, Ohio EPA Technical Bulletin MAS/1999-1-1). Similarly, Hall Run had only one sample, collected on September 14, that exceeded the proposed criteria value with a concentration of 1.01 mg/L. In contrast, two of the five dry weather samples and four of the six wet weather samples collected in Wolfpen Run exceeded the proposed criteria value of 1.0 mg/L.

In both the Hall Run and Shayler Run watersheds, dissolved ortho-phosphate levels were low ($\leq$ 0.09 mg/L) in all samples, averaging just 0.03 – 0.05 mg/L for both the wet weather and dry weather sample sets. Several samples were below the method detection limit of 0.02 mg/L. In Wolfpen Run, however, ortho-phosphate levels were considerably higher, averaging 0.16 mg/L in the dry weather samples and 0.23 mg/L in the wet weather samples. The Ohio EPA has not proposed criteria values for ortho-phosphates, so the potential impacts of these higher values is unknown at this time.

For Total Phosphorus (TP), the Ohio EPA has proposed an in-stream criteria value of 0.1 mg/L. Historically, a significant number of water samples collected throughout Clermont County have exceeded this threshold. In the 2006 ambient survey, two of the six dry weather samples from Hall Run had TP values of 0.10 mg/L exactly. The other samples were below this value. Of the seven wet weather samples collected at Hall Run, four had TP values at or above 1.0 mg/L, the highest being 0.18 mg/L on September 28. By contract, none of the Shayler Run dry weather samples exceeded 0.1 mg/L, while two of the seven wet weather samples had TP values of 0.1 mg/L and one sample, also collected on September 28, had a TP value of 0.12 mg/L. The remaining five wet weather samples in Shayler Run had TP values below 0.1 mg/L. As seen with NO_2-NO_3 and ortho-phosphate, the Wolfpen Run samples had TP values much higher than those samples collected at Hall Run or Shayler Run. All of the ambient samples collected at Wolfpen Run (dry weather and wet weather) had TP concentrations above the 0.1 mg/L proposed criteria value. In fact, one dry weather sample and four wet weather samples have TP values greater than 0.3 mg/L. The source of nutrient contamination in Wolfpen Run is not known, although possibilities include a package sewage treatment plant serving a mobile home park in the watershed, and a subdivision in the headwaters of the watershed with approximately 200 homes with discharging Home Sewage Treatment Systems (HSTSs). Data from samples taken directly from the mobile home park effluent are presented in the next section of this report.

Total Suspended Solids

Total suspended solids (TSS) concentrations were relatively low (> 4.0 mg/L) for all of the dry weather samples, as would be expected. The wet weather samples tended to have higher TSS values, but still did not exceed 25.0 mg/L. Results of ambient TSS sampling are presented in Table 3. By comparison, TSS concentrations in samples collected during storm events were significantly higher (see Wet Weather Sampling section of this report).

Table 3. Total Suspended Solids (TSS) in Hall Run, Shayler Run, and Wolfpen Run, May - October, 2006.

Sample Site	Average Dry Samples	Average Wet Samples	Minimum	Maximum
HALL0.2	2.18	6.74	< 1.00 (Dry)	14.00 (Wet)
SHYLR1.7	2.12	7.31	< 1.00 (Dry)	15.80 (Wet)
WLFPN0.1	1.32	7.99	< 1.00 (Dry)	24.80 (Wet)

All TSS concentrations expressed in milligrams per liter (mg/L).

E. coli

Samples were collected and analyzed for *E. coli* at each site. Ohio EPA criteria state that the *E. coli* geometric mean, based on not less than five samples collected over a 30-day period, cannot exceed 126 colony forming units (c.f.u.) per 100 mL, and *E. coli* content cannot exceed 298 c.f.u./100 mL in more than 10% of the samples. While the samples collected by the county in 2006 were taken over a longer period of time than the 30-day period in the OEPA criteria, a comparison of the county's data to the OEPA criteria is still useful. Results of the county's 2006 ambient *E. coli* sampling are presented in Table 4:

Table 4. *E. coli* concentrations in Hall Run, Shayler Run, and Wolfpen Run, May – October, 2006.

Sample Site	Geo. Mean Dry Samples	Geo. Mean Wet Samples	Minimum	Maximum
HALL0.2	266	920	150 (Dry)	> 8000 (Wet)
SHYLR1.7	12	764	<7.7 (Dry)	1100 (Wet)
WLFPN0.1	191	989	77 (Dry)	2600 (Wet)

All E. coli concentrations expressed as colony forming units per 100 milliliters (c.f.u./100 mL).

As expected, the *E. coli* geometric mean was greater during wet weather than dry weather at all three locations. However, even the dry weather geometric mean values for Hall Run and Wolfpen Run exceeded the OEPA criteria value of 126 c.f.u./100 mL. In Hall Run, 40% of the dry weather samples (2 of 5) had *E. coli* values greater than 298

c.f.u./100 mL. In Shayler Run and Wolfpen Run, 20% of the samples (1 of 5) exceeded this value.

All three watersheds showed evidence of significant contamination in wet weather sampling. In Hall Run, 83% of the wet weather samples (5 of 6) had *E. coli* concentrations greater than 298 c.f.u./100 mL, while all of the wet weather samples in Shayler Run and Wolfpen Run exceeded this value.

Ambient Sampling – Waste Water Treatment Plants

In addition to collecting samples from Hall Run, Shayler Run and Wolfpen Run on a bi-weekly basis, seven semi-public waste water treatment plants (or "package plants") located in the East Fork Little Miami River watershed were sampled periodically throughout the summer. Facilities sampled in this study included the Apple Orchard Mobile Home Park on SR 28 in Milford (also known as Orchard Lakes Mobile Home Park), which was given the sample designation AOMHP, the Clermont Christian Academy Summer Camp on Lindale – Mt. Holly Road in Monroe Township (sample designation CCA), Clermont Northeast High School on US 50 at Newtonsville – Hutchinson Road (Sample Designation CNE), the Forest Creek Mobile Home Park on Berry Road in Monroe Township (Sample Designation FCMHP), Holly Towne Mobile Home Park on SR 125 in Monroe Township (Sample Designation HTMHP), the Pleasant Hill Mobile Home Park on Wolfpen-Pleasant Hill Road in Miami Township (Sample Designation PHMHP), and the Royal Hill Mobile Home Park on SR 131 in Miami Township (Sample Designation RHMHP). Each site was sampled from four to seven times over the course of the 2006 sampling season, with samples being analyzed for nutrients (NO_2-NO_3, ortho-phosphate, and total phosphorus), total suspended solids (TSS), and *E. coli*. Results of these analyses are presented below.

Nutrients

Average nitrite-nitrate and phosphorus values are presented in Table 5 below, with the range of values shown in parentheses:

Table 5. Nutrient Concentrations in Package Plant Survey, May – October, 2006

Sampling Location	NO_2-NO_3 (mg/L)	Ortho-P (dissolved) (mg/L)	Total Phosphorus (mg/L)
AOMHP	8.59 (3.11 – 18.71)	2.10 (0.79 – 3.47)	2.37 (1.06 – 4.03)
CCA	50.38 (15.84 – 65.21)	2.75 (< 1.00 – 2.60)	2.91 (1.65 – 5.22)
CNE	0.67 (0.40 – 1.07)	0.04 (0.02 – 0.09)	0.09 (0.05 – 0.23)
FCMHP	28.56 (9.61 – 63.22)	5.03 (4.14 – 6.16)	5.19 (4.24 – 6.42)
HTMHP	30.07 (16.98 – 61.34)	2.91 (2.26 – 3.06)	3.08 (2.32 – 3.30)
PHMHP	8.59 (2.09 – 23.26)	2.14 (0.73 – 3.79)	2.50 (0.86 – 4.22)
RHMHP	10.75 (3.17 – 16.00)	2.41 (0.58 – 3.08)	2.84 (2.22 – 3.31)

Other than Clermont Northeast High School, all of the package plants sampled in this survey had extremely high nutrient values, relative to the samples collected in Hall Run, Shayler Run, and Wolfpen Run. Average nutrient values at the Apple Orchard Mobile Home Park were slightly lower to the other locations, but this might be due to the fact that this sample was collected from a culvert that collected effluent from the mobile home park package plant north of Bypass 28 and discharged it into a tributary to Happy Hollow located south of Bypass 28. If sampling occurred after a rain event, the culvert would also be carrying storm water runoff from the area north of the highway, which would dilute the package plant effluent.

Nitrite-Nitrate and Total Phosphorus values in all but the Clermont Northeast High School samples greatly exceeded the Ohio EPA proposed criteria values for these parameters. However, it should be noted that the package plants were sampled at or very near the point of discharge into the streams, and the Ohio EPA criteria values are based on in-stream concentrations outside the mixing zone for a point source discharge, so direct comparisons to these values are not appropriate. Regardless of this fact, it is apparent from the data that these systems contribute nutrients to their receiving streams and, depending on the discharge rates (volume per unit time), they may be contributing significantly to the overall nutrient loading in these systems. As for Clermont Northeast High School, a majority of the samples were collected during the summer when school is not in session. It may be more appropriate to sample during the school year to get a more accurate estimate of nutrient loads from this facility.

Total Suspended Solids

Total Suspended Solids (TSS) values for the package plant survey are presented in Table 6 below:

Table 6. Total Suspended Solids (TSS) in Package Plant Survey, May - October, 2006.

Sample Site	Average	Minimum	Maximum
AOMHP	2.79	< 1.00	6.00
CCA	1.48	< 1.00	2.60
CNE	4.02	1.30	6.50
FCMHP	<1.00	<1.00	< 1.00
HTMHP	<1.00	<1.00	< 1.00
PHMHP	8.47	<1.00	33.30
RHMHP	4.63	<1.00	23.40

All TSS concentrations expressed in milligrams per liter (mg/L).

Overall, the package plant effluents had Total Suspended Solids concentrations similar to the values observed in Hall Run, Shayler Run and Wolfpen Run. Two of the package plants (Forest Creek Mobile Home Park and Holly Towne Mobile Home Park) had Total Suspended Solids values consistently below the method detection limit of 1.00 mg/L.

E. coli

Geometric mean *E. coli* values for the package plant survey are presented in Table 7.

Table 7. *E. coli* concentrations in Package Plant Survey, May – October, 2006.

Sample Site	Geo. Mean	Minimum	Maximum
AOMHP	793	110	2,300
CCA	633	62	> 8,000
CNE	531	280	1500
FCMHP	12	< 7.7	69
HTMHP	57	< 7.7	2,100
PHMHP	6,736	3,000	> 8,000
RHMHP	21	< 7.7	1,700

All E. coli concentrations expressed as colony forming units per 100 milliliters (c.f.u./100 mL).

Unlike the nutrient and suspended solids data, the *E. coli* values showed a high degree af variability between the sites. Four of the seven sites had geometric mean values greater than the OEPA criteria value of 126 c.f.u./100 mL, with the Pleasant Hill Mobile Home Park greatly exceeding this threshold. The remaining three sites had very low *E. coli* concentrations, with several sampled not exceeding the method detection limit of 7.7 c.f.u./100 mL. One possible explanation for this discrepancy would be the extent to which each of these facilities uses chlorine or some other disinfectant in their treatment process. For many of the plants with discharge permits, a review of OEPA data reveals that most plants do not have problems meeting their bacteria limits but often exceed their chlorine discharge limits due to excessive addition of chlorine to disinfect their waste stream.

Dry Weather Surveys

As stated in the introduction, the county performed a series of dry weather studies during the summer of 2006 in an effort to identify potential illicit discharges in the Newtonsville and Happy Hollow areas of the county. The Newtonsville area has been sampled as part of the county's ambient monitoring program in prior years, and was shown to have poor water quality. This year's study was designed to focus in on potential sources of water quality impairment in the Newtonsville area, to determine if there were areas of impairment in the Happy Hollow watershed, and to identify potential sources of these impairments.

Sampling Locations

Grab samples were collected from nine sites in the Newtonsville area, three on the main stem of Newtonsville Creek, three on tributaries to the main stem, and three from stormwater outfalls. Seven sites were sampled in the Happy Hollow watershed, five on the main stem of Happy Hollow Creek and two on tributaries to the main stem. Surveys were performed in Newtonsville on August 7 and September 27. Happy Hollow was surveyed on August 18, but the samples were not analyzed for *E. coli*. Therefore, two additional surveys were performed, on September 11 and October 4. Maps of these sampling locations are presented in Figure 1 (Newtonsville) and Figure 2 (Happy Hollow) below:

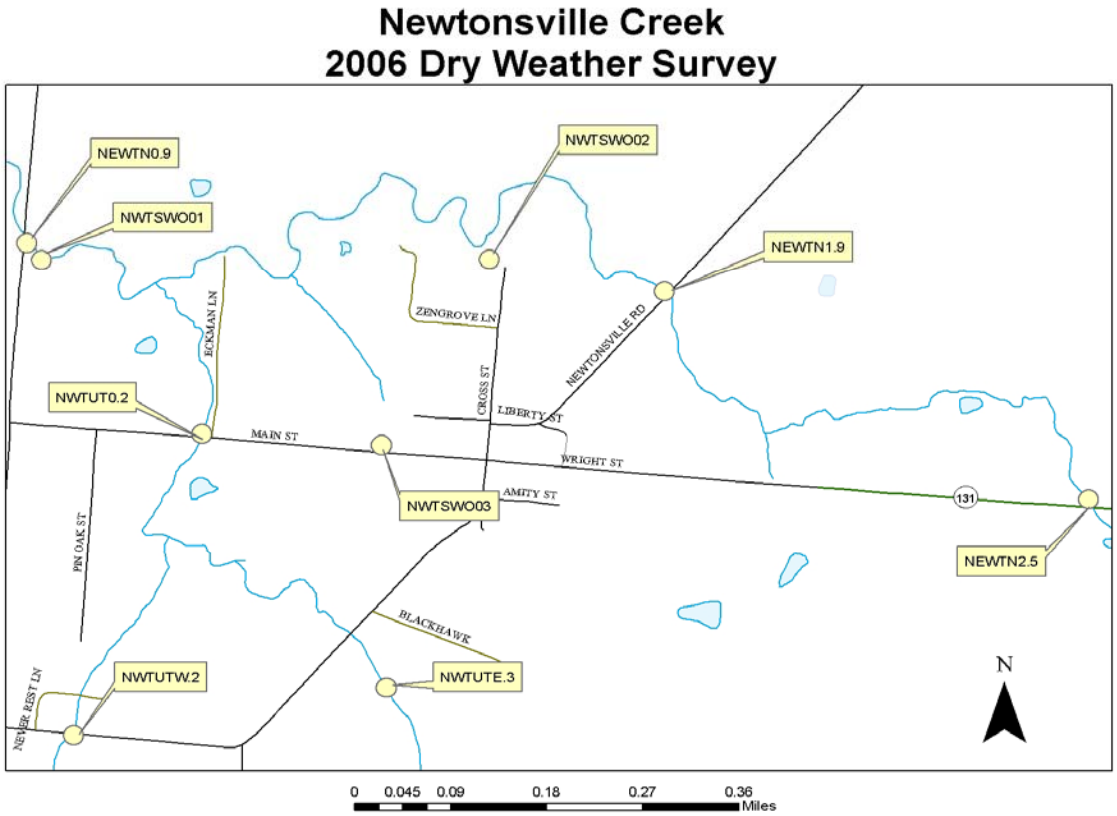

Figure 1. 2006 Dry Weather Survey - Newtonsville Sampling Locations.

The Newtonsville sampling focused on a section of the Newtonsville Creek watershed in the vicinity of the village of Newtonsville. The first sample (NEWTN2.5) is upstream of the village where the stream flows under SR 131. The designation comes from the fact that this location is 2.5 miles upstream of the confluence of Newtonsville Creek with Stonelick Creek. The next site (NEWTN1.9) is located where the stream passes under Newtonsville Road, and is 1.9 miles upstream of the confluence with Stonelick Creek. Moving downstream from here, the next site is identified as NWTSWO02. This is a stormwater outfall at the end of Cross Street that is connected to the stream via an open channel approximately 100 meters in length. The site identified as NWTSWO03 is another stormwater outfall sampled immediately north of Main Street. It is connected to the main stem of Newtonsville Creek by an open channel approximately 335 meters in length. Downstream from here, we find sampling locations identified as NWTSWO01, a stormwater outfall entering the stream just upstream of Cedarville Road, and NEWTN0.9, an in-stream sample taken just upstream of the Cedarville Road bridge 0.9 miles upstream of the confluence with Stonelick Creek. Three additional sites are located on un-named tributaries to Newtonsville Creek. One of these sites (NWTUT0.2) is located 0.2 miles upstream of the confluence of the tributary with Newtonsville Creek, where the tributary passes under Main Street. The other two sites (NWTUTE.3 and NWTUTW.2) are located on an eastern branch of the tributary 0.3 miles upstream of the point where the tributary forks, and on a western branch 0.2 miles upstream of the fork, respectively. Both of these sites are accessed from Wright Street.

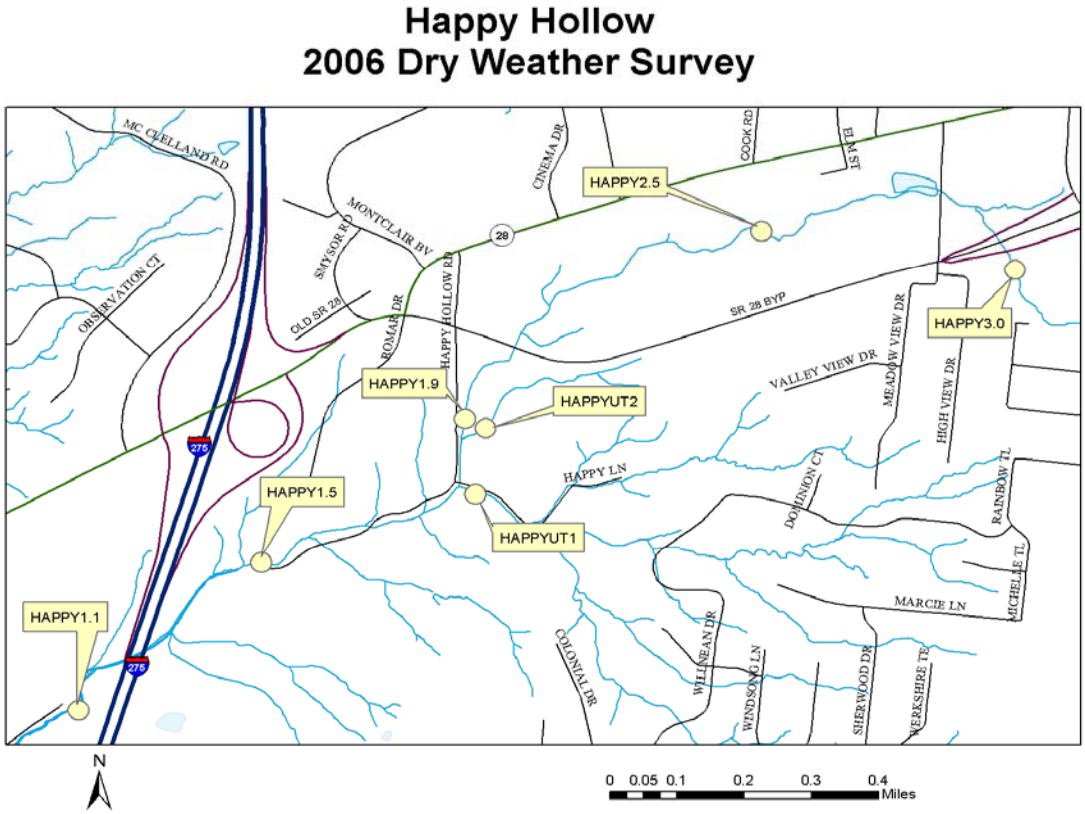

Figure 2. 2005 Dry Weather Survey – Happy Hollow Sampling Locations.

The first site in the Happy Hollow survey (HAPPY3.0) is located just upstream of the culvert carrying Happy Hollow under By-Pass 28, and is 3.0 miles upstream of the confluence of Happy Hollow with the East Fork Little Miami River. The next site (HAPPY2.5) is just downstream of the road connecting the Orchard Lakes Mobile Home Park with SR28. The next two sites (HAPPY 1.9 and HAPPY 1.5) are adjacent to the north section of Happy Hollow Road, before the stream passes under I-275. Two additional sites in this area (HAPPYUT1 and HAPPYUT2) are located on un-named tributaries just upstream of their respective confluences with the Happy Hollow main stem. The final site (HAPPY1.1) is located just downstream of I-275 and is accessed from the end of the south section of Happy Hollow Road.

Dry Weather Survey Results

Newtonsville Area

Results of the surveys conducted in the Newtonsville area are presented in Table 5 and Table 6 below:

Table 5. Nutrient Results from 2006 Newtonsvilleville Dry Weather Surveys.

Sampling Site	NO_2-NO_3	Ortho-P	TP
NEWTN2.5	0.46 (0.03-0.88)	0.36 (0.25-0.46)	0.61 (0.49-0.73)
NEWTN1.9	0.92 (0.61-1.22)	1.05 (0.30-1.80)	1.75 (1.27-2.23)
NWTSWO02	2.64 (1.10-4.18)	0.93 (0.49-1.36)	1.89 (1.07-2.71)
NWTSWO03	1.62 (1.30-1.93)	2.43 (1.34-3.52)	4.90 (4.54-5.26)
NWTSWO01	1.35 (1.30-1.40)	0.05 (0.03-0.07)	0.07 (0.04-0.10)
NEWTN0.9	1.05 (0.89-1.21)	0.17 (0.10-0.24)	0.24 (0.18-0.29)
NWTUT0.2	0.92 (0.55-1.28)	0.30 (0.18-0.41)	0.73 (0.34-1.11)
NWTUTE.3	0.42 (0.22-0.62)	0.03 (0.02-0.04)	0.18 (0.17-0.19)
NWTUTW.2	0.69 (0.58-0.80)	0.22 (0.06-0.38)	0.48 (0.35-0.60)

Results presented as average, with range in parentheses. All units are mg/L.

Table 6. Other Results from 2006 Newtonsville Dry Weather Surveys.

Sampling Site	TSS	*E. coli*
NEWTN2.5	37.35 (15.0-59.7)	417 (300-580)
NEWTN1.9	10.75 (6.5-15.0)	195 (38-1,000)
NWTSWO02	69.50 (65.0-74.0)	4,427 (1400-14,000)
NWTSWO03	50.35 (22.7-78.0)	14,697 (8,000-27,000)
NWTSWO01	3.15 (1.5-4.8)	134 (15-1,200)
NEWTN0.9	10.75 (4.4-17.1)	300 (180-500)
NWTUT0.2	34.60 (16.4-52.8)	1,470 (900-2,400)
NWTUTE.3	33.25 (13.3-53.2)	82 (23-290)
NWTUTW.2	46.80 (21.6-72.0)	263 (230-300)

TSS results presented as average, with range in parentheses. TSS units are mg/L.
E. coli results presented as geometric means, with range in parentheses. E. coli units are c.f.u./100 mL

NO_2-NO_3 was detected in all samples, with four samples having concentrations greater than the OEPA's proposed criteria value of 1.0 mg/L. Specifically, all three of the stormwater outfalls (NWTSWO01, NWTSWO02, and NWTSWO03) had NO_2-NO_3 concentrations above the proposed criteria value, as did the main stem site furthest downstream (NEWTN0.9). The main stem site located within the village of Newtonsville (NEWTN1.9) and one of the tributary sites (NWTUT0.2) both had average NO_2-NO_3 concentrations of 0.92 mg/L, with individual measurements exceeding the proposed criteria value of 1.0 mg/L. For the remaining three sites (NEWTN2.5, NWTUTE.3 and NWTUTW.2), all measurements were below this value. The ortho-phosphorus and total phosphorus data present a somewhat different picture. While two of the stormwater outfalls (NWTSWO02 and NWTSWO03) have the highest phosphorus concentrations, the third outfall (NWTSWO01), located just upstream of the Cedarville Road bridge, has the lowest phosphorus concentrations of any of the samples. Also, phosphorus concentrations are higher in the main stem of Newtonsville Creek in the village (NEWTN1.9) than they are downstream at the Cedarville Road bridge (NEWTN0.9), unlike the NO_2-NO_3 values. It should be noted that, while the OEPA has not proposed a criteria value for ortho-phosphate, for all but one of the sites sampled in these surveys (NWTSWO01), total phosphorus concentrations in every sample exceeding the proposed criteria value of 0.1 mg/L.

There are no existing or proposed criteria values for Total Suspended Solids and, as often observed under low flow conditions, suspended sediment values were relatively low compared to concentrations typically observed following rain events.

Ohio EPA criteria states that the *E. coli* geometric mean, based on not less than five samples collected over a 30-day period, cannot exceed 126 colony forming units (c.f.u.) per 100 mL, and *E. coli* content cannot exceed 298 c.f.u./100 mL in more than 10% of the samples. Since the dry weather surveys only involved two sampling events, results of the survey cannot be compared to these criteria values from a regulatory perpective, but the criteria values can still serve as a useful benchmark, and are used in this capacity in this report. As shown in Table 6, while several sites exceed a geometric mean of 126 c.f.u./100 mL, two of the stormwater outfalls (NWTSWO02 and NWTSWO03) have extremely high geometric mean *E. coli* values (4,427 c.f.u./100 mL and 14,697 c.f.u./100 mL respectively), suggesting some form of fecal contamination in these stormwater conveyances. High *E. coli* concentrations in the main stem samples may be due to runoff from these stormwater outfalls or the general influence of failing on-site home sewage treatment systems (HSTSs) or the presence on farm animals in the area. One interesting observation is the relatively high *E. coli* value at NWTUT0.2, the un-named tributary sampled at Main Street (geometric mean = 1,470 c.f.u./100 mL), given the fact that *E. coli* values in both branches of the tributary just upstream of this location have fairly low geometric means (82 c.f.u./100 mL for NWTUTE.3 and 263 c.f.u./100 mL for NWTUTW.2). There is very little development of any kind in this part of the watershed, but the "spike" in contaminants observed at NWTUT0.2 may be due to the influence of an undetected outfall in the area. This may warrant further investigation.

In general, the high nutrient and fecal contaminant concentrations observed in at least two of the stormwater outfalls within the Village of Newtonsville support earlier speculation that on-site HSTSs are not providing adequate treatment and are allowing partially treated sewage to enter the Newtonsville Creek watershed. Of particular concern is the fact that these outfalls are connected to the stream via open channels that flow through the village and are easily accessible by the residents of the village and their pets. With fecal contaminant concentrations orders of magnitude greater than state Primary Contact standards, this poses a significant risk of illness to residents of the village. The county is currently investigating options that would minimize or eliminate this risk. Options currently being considered include connection of the village to centralized sewers serviced by an existing wastewater treatment plant, or construction of a package treatment plant near the village. Input from the village and its residents will be an integral part of the decision-making process as the county moves forward in these efforts.

Happy Hollow

Results of sampling performed in the Happy Hollow Run watershed are presented in Table 7 and Table 8 below:

Table 7. Nutrient Results from 2006 Happy Hollow Dry Weather Surveys.

Sampling Site	NO_2-NO_3	Ortho-P	TP
HAPPY1.1	2.85 (2.02-3.80)	0.24 (0.20-0.27)	0.26 (0.24-0.28)
HAPPY1.5	3.90 (2.17-5.51)	0.35 (.027-0.44)	0.45 (0.37-0.50)
HAPPY1.9	0.60 (0.38-1.00)	0.12 (0.11-0.14)	0.15 (0.14-0.16)
HAPPY2.5	0.50 (0.42-0.62)	0.05 (0.02-0.07)	0.10 (0.06-0.12)
HAPPY3.0	0.40 (0.21-0.53)	0.14 (0.10-0.17)	0.19 (0.14-0.22)
HAPPYUT1	0.47 (0.31-0.73)	0.11 (0.11-0.11)	0.14 (0.14-0.15)
HAPPYUT2	10.42 (9.31-14.30)	2.01 (1.09-2.84)	3.22 (1.11-6.48)

Results presented as average, with range in parentheses. All units are mg/L.

Table 8. Other Results from 2006 Happy Hollow Dry Weather Surveys.

Sampling Site	TSS	*E. coli*
HAPPY1.1	2.87 (2.1-3.9)	91 (69-120)
HAPPY1.5	12.30 (7.0-18.8)	270 (270-270)
HAPPY1.9	5.27 (3.4-6.7)	203 (180-230)
HAPPY2.5	10.97 (6.3-13.5)	240 (230-250)
HAPPY3.0	6.07 (5.0-8.1)	253 (160-400)
HAPPYUT1	16.20 (5.7-23.5)	570 (130-2,500)
HAPPYUT2	14.97 (5.9-32.1)	248 (220-280)

TSS results presented as average, with range in parentheses. TSS units are mg/L.
E. coli results presented as geometric means, with range in parentheses. E. coli units are c.f.u./100 mL

In the Happy Hollow survey area, NO_2-NO_3 exceeded the proposed OEPA criteria value of 1.0 mg/L at three locations. The highest average value (10.97 mg/L) occurred at HAPPYUT2, an un-named tributary that originates along the south side of By-Pass 28 and enters the main stem of Happy Hollow just downstream of the HAPPY1.9 sampling

location. The other two sites in the watershed with elevated NO_2-NO_3 levels (HAPPY1.5 and HAPPY1.1) are the two main stem sites downstream of the confluence of this tributary. A similar trend is evident in the phosphorus data, with ortho-phosphorus and total phosphorus levels highest in the HAPPYUT2 samples, and concentrations elevated above background in the two main stem sites downstream of the tributary. As noted in the Newtonsville study, almost all of the samples analyzed in the Happy Hollow surveys had total phosphorus concentrations that exceed the proposed OEPA criteria value of 0.1 mg/L. However, the average value at HAPPYUT2 (3.22 mg/L) greatly exceeded all of the other average values in the study.

As noted in the Newtonsville study, Total Suspended Solids (TSS) values were low relative to historic values observed after rain events, as anticipated. Unlike the Newtonsville study, geometric mean *E. coli* values were at or near the proposed OEPA criteria values for all sites, with only one measurement (2,500 c.f.u./100 mL at HAPPYUT1 on September 11) exceeding 298 c.f.u./100 mL). It is not clear why this site would have elevated *E. coli* levels, although there is a cluster of homes with on-site HSTSs in the upper reaches of this watershed. There is no agricultural activity in the watershed.

In summary, nutrient concentrations appear to be highly elevated in the un-named tributary entering Happy Hollow just below River Mile 1.9. While this tributary originates on the south side of By-Pass 28, there is a culvert under the by-pass that appears to convey effluent from the package plant at the Apple Orchard Mobile Home Park to the tributary. This is one potential source of nutrients entering the watershed via this tributary. More specific data on the Apple Orchard Mobile Home Park is presented in the "Ambient Sampling" section of this report. A lack of high *E. coli* counts in these samples would indicate that the plant is doing an adequate job of removing these contaminants from its effluent, or the stream itself is efficiently assimilating these contaminants between the point of discharge and the sampling location. The latter is more likely, as samples collected at the outfall of the culvert under By-Pass 28 have significantly higher *E. coli* values than those samples collected at HAPPYUT2 (See Ambient Sampling section of this report).

Wet Weather Surveys

Results of the wet weather surveys conducted at the Hall Run and Shayler Run autosampler stations are presented in Table 9 and Table 10, respectively.

Table 9. Hall Run Wet Weather Sampling Results, May - October, 2006.

July 28, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	0.58	0.05	2.85	1,820.0	> 8,000
Peak/Level	0.76	0.07	4.36	1,490.0	>8,000
Falling	1.04	0.09	0.63	249.0	7,800

September 18, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	0.46	0.04	N/A	10.0	100
Peak/Level	0.40	0.04	N/A	13.6	1,000
Falling	0.31	0.04	N/A	2.4	230

October 5, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	0.60	0.07	0.41	173.0	2,500
Peak/Level	0.70	0.12	0.35	78.5	4,200
Falling	0.81	0.10	0.24	50.5	5,200

October 11, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	N/A	N/A	N/A	N/A	N/A
Peak/Level	0.08	0.06	0.33	119.0	730
Falling	0.10	0.09	0.15	6.6	1,300

All measurements in mg/L except E. coli, which is reported in c.f.u./100 mL.

Table 10. Shayler Run Wet Weather Sampling Results, May - October, 2006.

July 28, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	0.49	0.04	1.09	520.0	3,900
Peak/Level	0.56	0.07	0.93	466.0	> 8,000
Falling	0.48	0.02	0.35	142.0	4,900

September 18, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	0.24	0.04	N/A	313.0	4,700
Peak/Level	0.36	0.07	N/A	368.0	>8,000
Falling	0.42	0.09	N/A	057.0	6,800

September 28, 2006

Stream Stage	NO_3-NO_2	Ortho-P	TP	TSS	*E. coli*
Rising	N/A	0.05	0.14	15.9	370
Peak/Level	N/A	0.05	0.15	11.6	47
Falling	N/A	0.07	0.12	12.0	1,100

October 5, 2006

Stream Stage	NO_2-NO_3	Ortho-P	TP	TSS	*E. coli*
Rising	0.40	0.04	0.14	7.8	620
Peak/Level	0.68	0.13	0.85	323.0	> 8,000
Falling	0.79	0.12	0.57	205.0	> 8,000

October 11, 2006

Stream Stage	NO_2-NO_3	Ortho-P	TP	TSS	*E. coli*
Rising	0.08	0.04	0.08	4.1	480
Peak/Level	0.03	0.03	0.16	19.7	1,600
Falling	1.05	0.09	0.32	85.3	> 8,000

All measurements in mg/L except E. coli, which is reported in c.f.u./100 mL.

Samples collected on September 18 were not analyzed for Total Phosphorus due to a problem at the laboratory. Likewise, samples collected from Shayler Run on September 28 were not analyzed for Nitrates. In Hall Run on September 28, the stream rose in several stages, making it impossible for the autosampler to capture the initial flush of storm water as intended. Therefore, these samples were discarded. In the wet weather event in Hall Run on October 11, the first set of samples was collected just after the stream had peaked. Therefore, only "Peak/Level" and "Falling" samples were collected.

The Hall Run wet weather surveys produced nitrite-nitrate and ortho-phosphate data similar to the ambient sampling performed at this location, especially for those ambient samples collected following rain events. However, total phosphorus levels in the wet weather surveys tended to be higher than those observed in the ambient samples,

especially in wet weather events in which high levels of suspended solids were observed. This correlation is not surprising, given that phosphorus is known to absorb to soils and other particulate matter. Also, some of the wet weather samples, notably those from the July 28 and October 5 events, had extremely high *E. coli* values. Such evidence of fecal contamination has also been seen in both ambient and wet weather surveys in previous years. Figure 3 shows a map of the Hall Run watershed with the location of discharging and non-discharging home sewage treatment systems (HSTSs). Note the high concentration of discharging systems in the Pepper Ridge subdivision, located on a tributary to Hall Run just upstream of the sampling site. If the HSTSs in this area are not fully treating the waste they receive, this could be a potential source of the high *E. coli* values observed in this study. Clermont County also has a sewer line running parallel to Hall Run, and any leaks or accidental discharges from this line would also lead to elevated *E. coli* concentrations in the stream. A 5-million gallon equalization basin has been installed in the headwaters of Hall Run and should help to mitigate any impacts from this system.

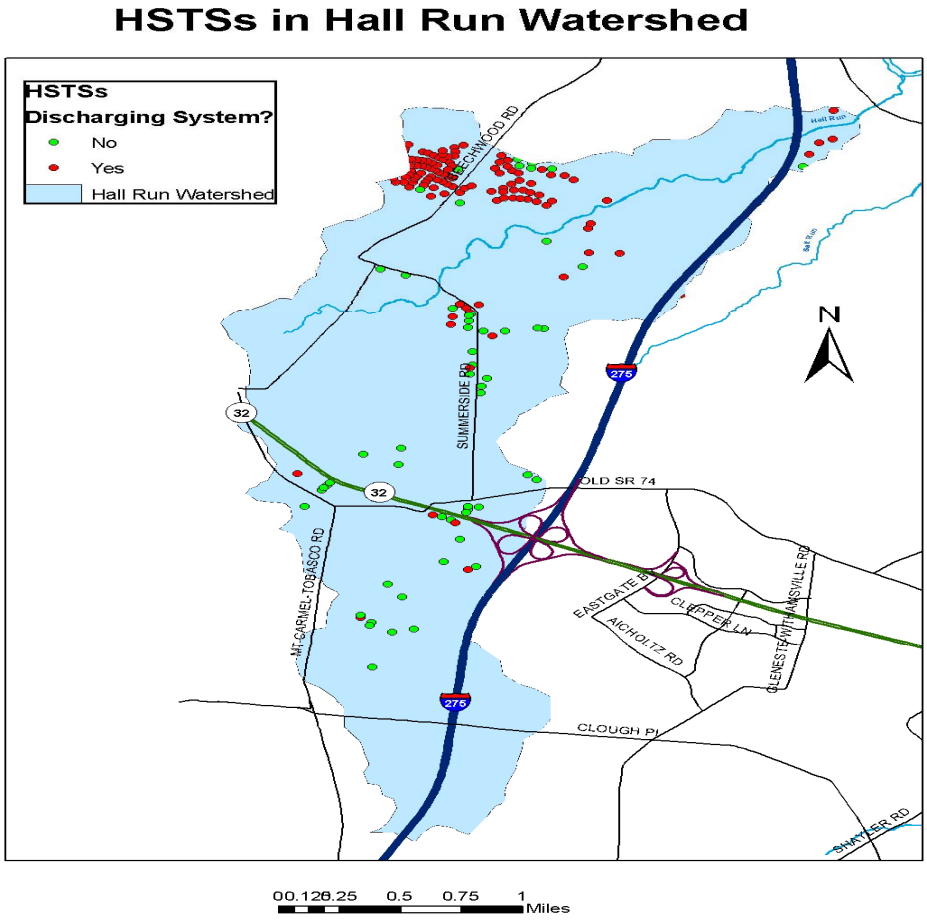

Figure 3. Hall Run Watershed showing location of Home Sewage Treatment Systems

Results for the Shayler Run wet weather surveys are similar to those in Hal Run, in that the nitrite-nitrate and ortho-phosphorus levels are not significantly different from those observed in the ambient samples. Total phosphorus and total suspended solids values showed a correlation similar to that observed in the Hall Run data, although concentrations of both parameters were lower overall in Shayler Run. *E. coli* concentrations, on the other hand, were as high or higher than those observed in Hall Run, with four of the five Shayler Run surveys producing at least one *E. coli* value greater than 8000 c.f.u./100 mL. From an analysis of Figure 4, there are no obvious concentrations of discharging HSTSs in Shayler Run, as there is in Hall Run. Other potential sources for fecal contamination in the stream include the sewer line running parallel to the stream. This has caused problems in the past due to overflow associated with storm water infiltration, and the county is in the process of replacing the sewer line and installing a 5-million gallon equalization basin to avoid future problems. Another potential source of fecal contamination in the watershed would be from animals, either wild or domestic. While there are no large cattle farming operations in the area, there are a number of horse farms that may be contributing to the problem through improper management of manure. Due to the fact that the watershed is highly residential, pet waste may also contribute to the observed contamination.

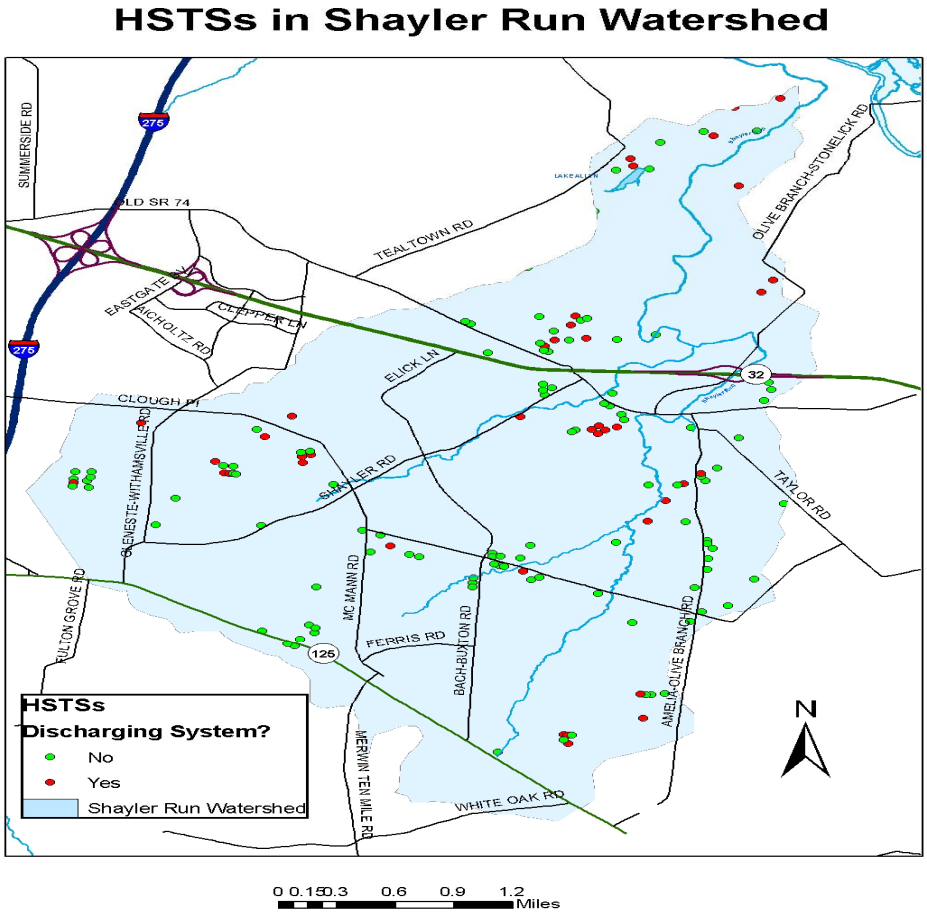

Figure 4. Shayler Run Watershed showing location of Home Sewage Treatment Systems

Conclusions/Recommendations

- Include package plant nutrient loads in TMDL model for EFLM.
- Work with OEPA and Clermont County General Health District to address semi-public WWTPs.
- Work with OEPA and the General health District to address the Semi-private WWTP and subdivision with discharging HSTSs in the Wolfpen Run watershed, and continue to monitor the stream for improvements in water quality as these problems are addressed.
- Work with Village of Newtonsville to eliminate contamination of Newtonsville Creek through centralized sewers or installation of a package treatment plant.
- Investigate Pepper Ridge as potential source of Hall Run fecal contamination.
- Source identification of Shayler Run *E. coli* (human vs. animal).
- Continue to monitor Shayler Run to document improvements in WQ associates with sewer upgrades.
- Monitor the CNE plant during the school year, when it is likely to be in heavier use.
- Monitor for total residual chlorine at the semi-public WWTPs.
- Further investigation of the NTWUT0.2 site to identify pollutant source(s).
- Continue wet weather sampling on Hall Run and Shayler Run to determine the effectiveness of the sewer system improvements being implemented.
- Others?